Intensive Computation

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Part 2

Exercise 1 (5 points)	
Exercise 2 (5 points)	
Question 1 (5 points)	
Exercise 3 (6 points)	
Question 2 (5 points)	
Exercise 4 (6 points)	
Total (32 points)	

- Student's Name -

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- *Matricola* number -

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Exercise 1 (5 points) – Interconnection Networks

a) Design a Clos network of size 120 x 120, using in the first stage modules having 18 inputs. Consider both cases, **strictly non-blocking** and **rearrangeable** network.

b) Compare the cost of the two Clos networks designed in the previous point with:

   i. The crossbar 120 x 120

   ii. The butterfly of size N=128 (128 inputs and outputs).

Exercise 2 (5 points) – Interconnection Networks

Briefly explain how the routing algorithm works for a **Benes network.**

Consider a Benes network of size N=8 and show how to realize permutation $P = \begin{pmatrix} 0\,1\,2\,3\,4\,5\,6\,7 \\ 7\,2\,5\,4\,1\,6\,0\,3 \end{pmatrix}$

Question 1 (5 points) – Interconnection networks

Illustrate the design of an XGFT(3; 4, 2, 2; 1, 4, 1), specifying how many nodes there are on each level, how many parents and children they have, and then showing the drawing of the network.

Exercise 3 (6 points) – Quantum circuits

Consider the two-qubit transformations U1 and U2 shown below

- where $\mathrm{Y} = \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$ and $\mathrm{Z} = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$
- Show what transformations U1 and U2 represent, writing the associated 4x4 matrices.
- Show how U1 and U2 act on the states $|00\rangle = |0\rangle \otimes |0\rangle$ and $|10\rangle = |1\rangle \otimes |0\rangle$.

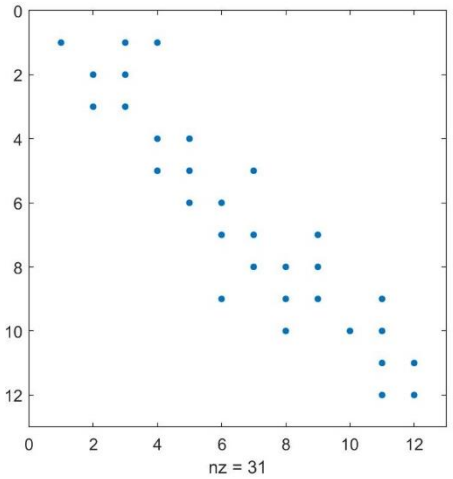
Question 2 (5 points) – Quantum circuits

Explain how the Bloch sphere is used to represent qubits.

Exercise 4 (6 points) – Sparse matrices

Consider the sparse matrix 12x12 and its pattern shown here below

	1	2	3	4	5	6	7	8	9	10	11	12
1	**834**		**234**	**928**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
2	**0**	**625**	**234**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3	**0**	**137**	**761**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4	**0**	**0**	**0**	**819**	**765**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
5	**0**	**0**	**0**	**345**	**826**	**0**	**321**	**0**	**0**	**0**	**0**	**0**
6	**0**	**0**	**0**	**0**	**275**	**741**	**0**	**0**	**0**	**0**	**0**	**0**
7	**0**	**0**	**0**	**0**	**0**	**234**	**425**	**0**	**876**	**0**	**0**	**0**
8	**0**	**0**	**0**	**0**	**0**	**0**	**273**	**758**	**854**	**0**	**0**	**0**
9	**0**	**0**	**0**	**0**	**0**	**197**	**0**	**234**	**928**	**0**	**541**	**0**
10	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**549**	**0**	**546**	**765**	**0**
11	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**379**	**547**
12	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**674**	**425**



a) Specify which arrays you need for the following compressed representations and how many bytes they occupy in memory.

b) Explain how arrays change after the insertion of the elements $m_{6,1}$=765 and $m_{9,4}$= 304 and what is the new memory occupation.

c) Explain how arrays change after the cancellation of elements $m_{1,4}$ and $m_{9,11}$ and what is the new memory occupation.

BSR with 3x3 blocks

Ellpack-Itpack